U. S. DEPARTMENT OF AGRICULTURE

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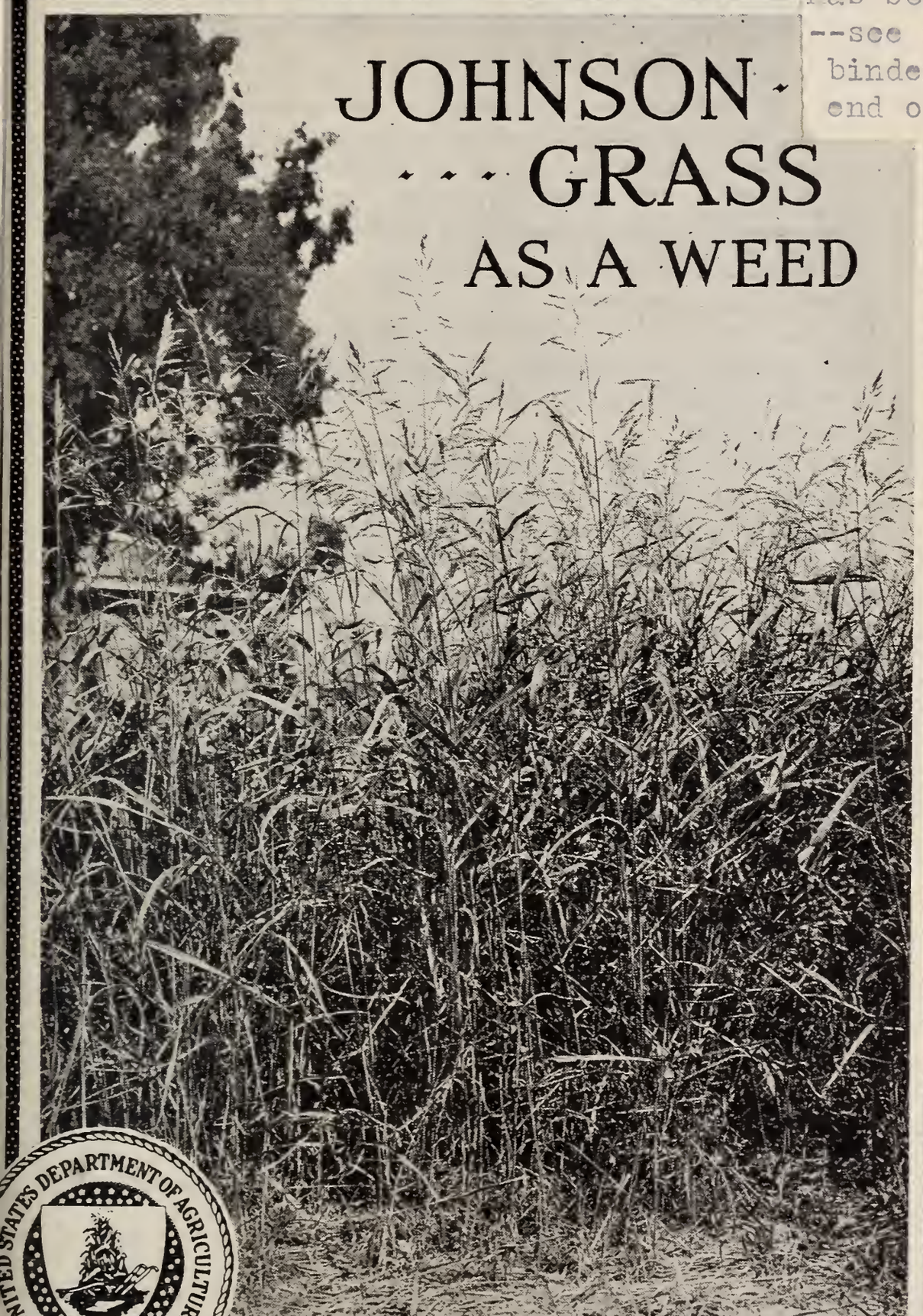
JOHNSON GRASS AS A WEED



JOHNSON GRASS is a troublesome weed, common in the Southern States and locally distributed in the far West. It spreads both by seeds, scattered in many ways, and by vigorous rootstocks, small pieces of which can produce new plants.

Instead of attempting to eradicate Johnson grass by laborious and expensive methods on areas in which it is very abundant, it often is more profitable to utilize the plant as a hay crop in rotation with intertilled crops such as corn. This has been done successfully in several localities in the Cotton Belt.

Farm and other conditions vary widely within the extensive range of Johnson grass, and details of effective control methods in different regions vary accordingly. In attempting to clean fields of Johnson grass by any method, the threefold aim should be (1) to exhaust existing rootstocks and to prevent the growth of new ones, (2) to kill new seedlings, and (3) to prevent the ripening and scattering of seeds. Attempts at eradication in fields in which the grass is well established are useless unless a thorough job can be done.

In deep-plowed cultivated fields Johnson grass usually develops a deep mass of rootstocks difficult to subdue, but in closely grazed pastures and frequently mowed meadows the rootstocks are comparatively small and shallow, and consequently easier to kill. One way to control the grass, therefore, is to cut it for hay before blossoming every time a new growth is sent up, or, better, to pasture it closely, for two seasons, then to plow shallow and use extra care in preparing the ground for the next crop and in cultivating it.

Where conditions warrant the cost, in arid regions particularly, Johnson grass can be killed by bare fallow; that is, by cultivation so persistent and thorough that green growth aboveground is prevented. Careless tillage usually stimulates the grass.

Where conditions are favorable for its growth, alfalfa is a helpful control crop. Other ways by which to hold the weed in check are locally feasible. In waste places, such as fence rows, railroad rights of way, and ditch banks, the ripening of seeds should be prevented by any practicable means.

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JOHNSON GRASS AS A WEED[1]

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WHERE JOHNSON GRASS IS MOST TROUBLESOME

Johnson grass,[2] a native of the Mediterranean region, was introduced into the United States many years ago. It is now common in the South and occurs more locally in the far West. It has merit as a forage plant, but it spreads both by seeds and by vigorous rootstocks, and once established it persists stubbornly in cultivated fields. Consequently it is regarded in most localities as a weed. Johnson grass "is commonly perennial north to the thirty-eighth parallel, which passes through the northern part of Kentucky and central Missouri,"[3] but in the northern part of its range it usually is killed in cold winters. It has persisted locally, however, for several years in southern Iowa,[4] central Indiana,[5] and southern Ohio,[6] and it is found as far north as Oregon and Washington. It is most tenacious on rich soils such as alluvial river bottoms, the black soils of the Cotton Belt, and irrigated lands of the West. On poor upland soils the grass is more easily controlled.

ROOTSTOCK HABITS OF JOHNSON GRASS

As those familiar with Johnson grass are fully aware, most of the difficulty in its eradication comes from the underground stems or rootstocks,[7] small fragments of which may take root and grow into

[1] This bulletin is based on the following: Cates, J. S., and Spillman, W. J. A method of eradicating Johnson grass. U. S. Dept. Agr. Farmers' Bul. 279, 16 pp., illus. 1907, supplemented by more recent information obtained largely from the publications cited in the text.

[2] *Holcus halepensis* L.; *Sorghum halepense* (L.) Pers.

[3] Vinall, H. N. Johnson grass: its production for hay and pasturage. U. S. Dept. Agr. Farmers' Bul. 1476, 20 pp., illus. 1926.

[4] Pammel, L. H., and King, C. M. Johnson grass as a weed in southwestern Iowa. Iowa Agr. Expt. Sta. Circ. 55, 4 pp., illus. 1919.

[5] Hansen, A. A. Recent Indiana weeds. Ind. Acad. Sci. Proc. (1922) 38: 294. 1923.

[6] Willard, C. J. Note concerning Johnson grass as a weed in Ohio. Jour. Amer. Soc. Agron. 17: 755–756. 1925.

[7] Farmers generally do not distinguish between these underground stems or rootstocks and the true roots. The rootstocks differ from roots in that they are jointed, like stems, and have the rudiments of leaf sheaths at the joints.

new plants. Clues to effective methods of killing Johnson grass were obtained by Cates and Spillman [8] through careful studies of the rootstocks, which for convenience of description were classified as primary, secondary, and tertiary.

In this classification primary rootstocks embrace all those which are alive in the ground at the beginning of the growing season in the spring. Observations indicate that these rootstocks decay after the growing season is over, and that only the new ones—secondaries and tertiaries—live over the following winter.

Secondary rootstocks are those which arise from the primaries, come to the surface, and there form crowns, thus producing new plants. Secondary rootstocks as a rule are no larger in diameter than the primary rootstocks from which they spring, and their length is determined by the depth to which the primary rootstocks are buried.

Tertiary rootstocks are those that a Johnson-grass plant sends out from the base of its crown about flowering time. These large, deeply penetrating rootstocks cause much mischief the following year. The longer the plants are allowed to stand after blossoming, the larger and deeper these tertiary stems become. When the ground is soft, and especially when a large top is allowed to develop, tertiary rootstocks grow to a large diameter, occasionally three-eighths of an inch, and penetrate to a great depth, sometimes as much as 4 feet and commonly from 15 to 30 inches. At other times, when the soil is compact and especially when by reason of mowing or grazing, or both, the plant is not allowed to develop extensively aboveground, these tertiary rootstocks are smaller in diameter and run along just under the surface, cropping out at intervals to form new plants.

By this classification secondary and tertiary rootstocks of one year become primary rootstocks at the beginning of the following year.

INFLUENCE OF FARMING SYSTEMS ON ROOTSTOCK DEVELOPMENT

Determined largely by the way the land had been cropped, four rather distinct types of rootstock development were recognized by Cates and Spillman, as follows:

(1) On corn or cotton land poorly cultivated during the early growing season, particularly on cornland, which is not cultivated as carefully as cotton land, Johnson grass is not killed by the imperfect tillage but grows up luxuriantly after cultivation has ceased. As a result the plant flowers and matures seed, and large tertiary rootstocks bore deep into the soft soil. This is considered the very worst type of Johnson-grass development, since these deep rootstocks, which contain a large quantity of stored food, can continue to send up growth and establish new plants the following year, usually until the latter part of August, even though the tops are kept closely cut by cultivation. As the soil warms up with the advancing season, rootstock sprouts appear on cultivated land from greater and greater depths. Rootstocks have been found sprouting from a depth of more than 20 inches beneath the surface.

In Figure 1, which shows a cross section of this kind of land photographed in November, the tertiary rootstocks are 20 inches in depth. The field had been in corn the year before and in cotton during the year in which the photograph was taken.

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[8] See footnote 1.

(2) If the Johnson-grass plant is kept closely cropped and is not allowed to develop very much above the ground, there will be but little growth beneath the surface, although a small amount of tertiary development will be made in the latter part of the season, whether the plant is allowed to form seed or not. The tendency of the Johnson-grass plant seems to be to form seed before making very much tertiary growth.

In Figure 2 is shown a cross section of a field in corn during the preceding year but pastured during the year in which the photograph was taken. Here the tertiary rootstocks penetrated only about 2 inches beneath the surface. There was but little secondary growth.

(3) It is a rather common practice, in order to obtain the best yields of hay, to break Johnson-grass land in the spring every two or three years. On this freshly broken land the rootstocks develop in a rather thick mat to the depth to which the land has been plowed. On this kind of land Johnson grass would be very troublesome if an attempt were made to grow a cultivated crop the next season.

FIG. 1.—Cross section showing deep development of rootstock of Johnson grass, as found in late summer in a poorly cultivated corn or cotton field

This third type of rootstock development is shown in Figure 3. This is meadow land which was "broken broadcast" in March and the cross section photographed the following June. The small rootstocks near the surface the preceding year were buried deeper, and the rootstocks shown in the picture are for the most part the secondary growth sent out to reach the surface.

(4) On old meadow land the primary rootstocks of Johnson grass are near the surface and develop but little secondary growth. The tertiary growth likewise is small.

This condition is pictured in Figure 4. This photograph also was taken in June, but in an unplowed section of the meadow. The old

rootstock which produced the plant has disappeared. Its stored food has been absorbed in making the new plant, and the shallow rootstock itself has rotted away. The little white stems starting from the base of the crown of the plant are new tertiary rootstocks. On such hard land, however, especially if it is kept mowed regularly, these rootstocks are not likely to penetrate deep or to attain a large diameter.

Experience has demonstrated clearly that Johnson-grass plants that have attained the state shown in Figures 2 and 4 are more easily killed than are plants with the deeper, more vigorous development of rootstocks illustrated in Figures 1 and 3.

METHODS OF CONTROLLING JOHNSON GRASS

Where Johnson grass does not occur, great care should be taken to keep it out. On many farms, however, the grass has gained a firm foothold, and extermination may be impracticable under existing farming conditions and farm practices. On such lands careful consideration should be given to the cost and difficulty of eradicating the grass and to the likelihood of its reappearance through seeds carried by overflow, drainage, or irrigation water, or by other agencies. Moreover, new plants may be expected for several years from seeds whose germination has been delayed.[9] Under some conditions eradication is important and practicable, especially in irrigated districts of the Southwest. In many localities in the Cotton Belt, Johnson grass is very abundant and persistent. In such places it sometimes is more profitable not to attempt extermination, but to adjust the cropping system so as to utilize the grass as a hay crop.[10] This has been done successfully in several localities.

FIG. 2.—Cross section showing small and shallow rootstock development of Johnson grass, as commonly found in closely pastured land

[9] See footnote 3.

[10] A detailed discussion of the forage value of the plant, both on permanent grasslands and in rotations in which corn or some other crop can be grown for one season after the meadow has been plowed, is contained in the following bulletin: VINALL, H. N. JOHNSON GRASS: ITS PRODUCTION FOR HAY AND PASTURAGE. U. S. Dept. Agr. Farmers' Bul. 1476, 20 pp., illus. 1926. This publication may be obtained on request from the United States Department of Agriculture, Washington, D. C.

In attempting to clear Johnson grass from fields by any method the aim should be (1) to weaken and kill existing rootstocks and to prevent the formation of new ones, (2) to kill seedlings from seeds already in the soil, and (3) to prevent the ripening and scattering of more seeds. Control of seed production, as pointed out years ago by Ball[11] and others, is especially important. Attempts to exterminate Johnson grass in fields in which it is well established are useless unless a thorough job can be done.

CLOSE PASTURING OR MOWING, FOLLOWED BY SHALLOW PLOWING AND TILLED CROPS

From the rootstock habits of growth already described, Cates and Spillman concluded that a logical first step in Johnson-grass eradication would be to turn the land into meadow or pasture and, every time a new growth is sent up, to mow the grass for hay before it blossoms, or, better, to pasture it closely, for one or more seasons, in order to prevent seeding and to induce a shallow rootstock system. Then the land should be broken to a very shallow depth, just deep enough to turn up all the rootstocks, usually 3 to 4 inches. A cultivated crop which can be given extra attention should then be planted. The shallow plowing tends to keep the rootstocks near the surface and gives them less opportunity to produce secondary growth. Although the breaking is shallow, the work should be done thoroughly, and it is best to rebreak in early spring in order to stimulate growth from the primary rootstocks early in the season and thus exhaust them more quickly.

FIG. 3.—Cross section showing the large growth of secondary rootstocks of Johnson grass when an old sod is plowed deep in the spring

This shallow plowing is reported to be very effective during the dry part of the summer, especially in the Southwest; but plowing

[11] BALL, C. R. JOHNSON GRASS. U. S. Dept. Agr., Bur. Plant Indus. Bul. 11, 24 pp., illus. 1902.

Johnson-grass sod when the soil is dry is slow, expensive, and hard on horses. If the climate is such that there are many alternate freezes and thaws during the winter, shallow winter breaking will be effective. If both summer and winter treatments fail, or if it is more convenient, careful plowing in early spring is still effective. The main point is to get a shallow rootstock system, and then, in breaking, to keep the rootstocks near the surface, where they can be reached by summer sun or winter freezing; or, if the work is delayed until spring, so that the secondary rootstock growth will amount to but little, then by close cultivation to destroy the young plants before they begin to form flowering heads.

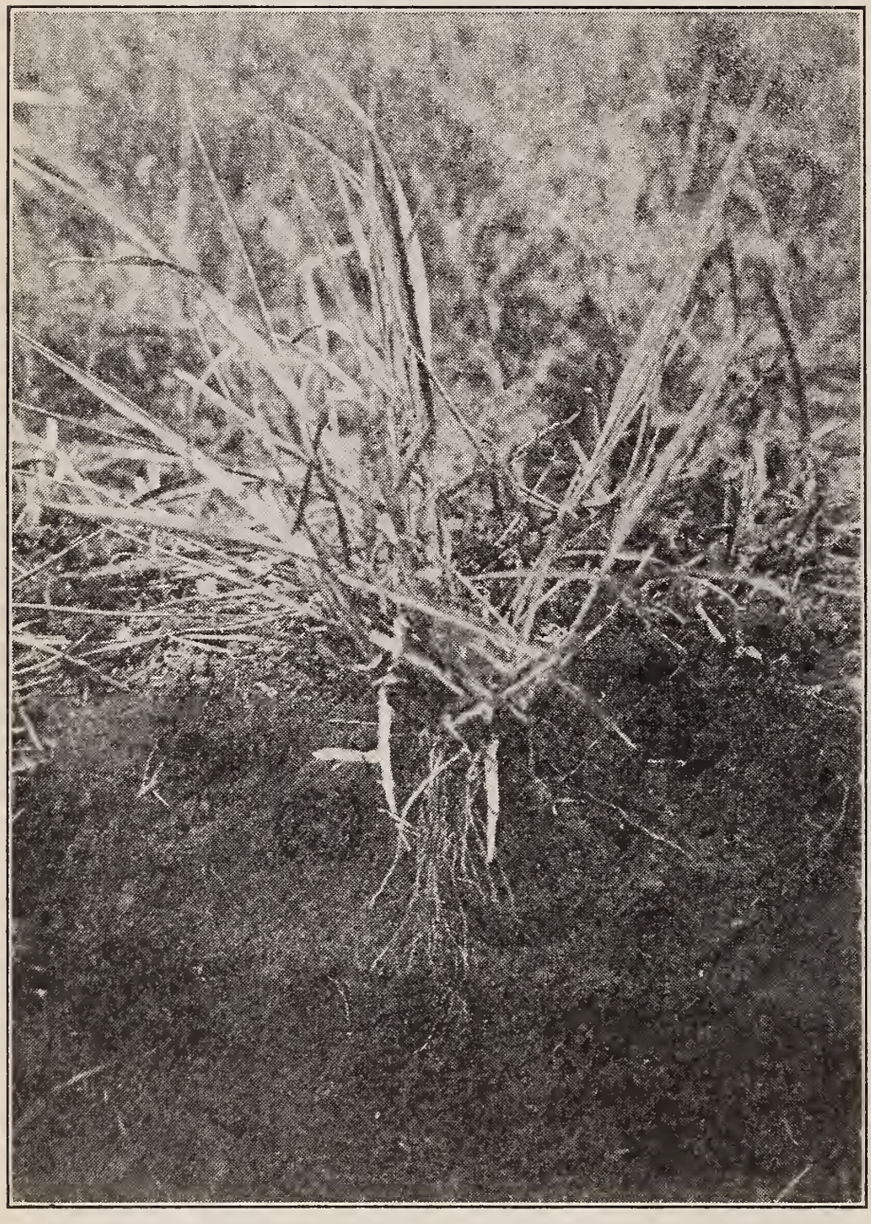

FIG. 4.—Cross section showing small tertiary growth and practically no secondary growth of Johnson grass on an old sod which has not been broken for several years

These general principles of control are widely indorsed, although, naturally, no one detailed method is regarded as equally effective and practical on all farms, because farming and other conditions differ widely in different regions. In Louisiana, Perkins[12] recommends close grazing by livestock for two years as a practicable way to thin and weaken the grass before an attempt is made to grow sugar cane or cotton on the infested land. Repeated shallow plowing before planting time was considered the most practicable way to control Johnson grass on crop land. Three shallow plowings, the first in January and the last in April, followed by harrowing and planting to corn, were reported to be very effective in one locality.

Pollock[13] recommends that, before one attempts to grow a cultivated crop on a Johnson-grass meadow in sections of Texas where the winters are mild, the field be pastured heavily or mowed close to the ground for two years, then plowed shallow in the spring and planted to some intensively cultivated crop. "In sections where

[12] PERKINS, W. R. JOHNSON GRASS. La. Agr. Col. Ext. Circ. 10, 7 pp. 1916.
[13] POLLOCK, E. O. JOHNSON GRASS IN TEXAS. Tex. Agr. Expt. Sta. Circ. 43, 15 pp., illus. 1927.

it is unusually dry, heavy pasturing followed by summer fallowing will usually reduce the stand of plants to such an extent that an intertilled crop may be grown in the following summer without difficulty." A method reported as effective in northern Texas consists of repeated winter plowing, followed in the spring by planting cotton, corn, or some other crop that requires intensive cultivation, including hand-pulling of scattered plants in August or September.

In Mississippi, Ricks [14] recommends several shallow plowings of Johnson-grass land in the fall and winter, the land being left rough each time and planted the following season to a clean-cultured crop. The next fall and winter the shallow plowings should be repeated. In a later publication Brown and Ricks [15] recommend two or three years of this kind of treatment. Ricks states also that the weed can be partially controlled by close and continuous grazing for several seasons.

Heard [16] advises the adoption of a combination of methods which distributes labor properly, keeps up soil fertility, and returns a steady income. Methods recommended as effective and economical under Arizona conditions include: (1) Overgrazing with sheep, meanwhile irrigating frequently in order to encourage top growth of Johnson grass and thus more quickly exhaust the food stored in the rootstocks; (2) frequent cultivation of a late summer crop, such as corn, followed by another crop demanding much tillage, such as cotton; and (3) dry fallow or pasturing in summer, followed by winter grains.

To weaken Johnson grass under North Carolina conditions, Burgess and Waldron [17] indorse the practice of letting infested land run to Johnson-grass meadow, or seeding it to other grasses in addition, and following this by mowing for a year or two.

According to Roberts,[18] "Briefly stated, eradication of Johnson grass [in Kansas] requires pasturing or mowing for at least a year, followed by shallow plowing in a dry period of late summer or at the beginning of winter." Land badly infested with Johnson grass should be mowed or pastured for two consecutive years before plowing. Extra care and attention should be given to any cultivated crop planted the following spring.

In writing of Johnson-grass eradication in New Mexico, Overpeck [19] alludes to the value of heavy grazing followed by thorough tillage of a cultivated crop, such as corn or cotton.

According to Vinall,[20] "Pasturing Johnson grass weakens it considerably and causes the rootstocks to be produced near the surface, thus making it easier to destroy the grass." Regarding the rare reports of prussic-acid poisoning of farm animals from eating this grass, the comment is made that the grass has been pastured for years in the Southern States without trouble, and that "it therefore seems

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[14] RICKS, J. R. FORAGE CROPS. Miss. Agr. Expt. Sta. Bul. 172: 7, illus. 1915.
[15] BROWN, H. B., and RICKS, J. R. GRASSES AND FORAGE PLANTS. Miss Agr. Col. Ext. Bul. 3: 3. 1917.
[16] HEARD, H. C. JOHNSON GRASS CONTROL. Ariz. Agr. Expt. Sta. Bul. 82: 339–355, illus. 1917.
[17] BURGESS, J. L., and WALDRON, C. H. FARM WEEDS OF NORTH CAROLINA AND METHODS FOR THEIR CONTROL. N. C. Dept. Agr. Bul. 259: 4, illus. 1919.
[18] ROBERTS, H. F. PRINCIPAL NOXIOUS WEEDS OF KANSAS. Kans. Agr. Expt. Sta. Circ. 84: 46, illus. 1920.
[19] OVERPECK, J. C. JOHNSON GRASS ERADICATION. N. Mex. Agr. Expt. Sta. Bul. 146, 15 p., illus. 1925.
[20] See footnote 3.

practicable, except in cases of extreme drought, to disregard the slight possibility of poisoning * * *."

INTENSIVE TILLAGE PRACTICES

In arid regions particularly Johnson grass can be killed by bare summer fallow, namely, clean cultivation repeated at frequent intervals to keep down all vegetation. A main objection to this practice is the cost, both in labor and in nonuse of the land.

On a 3-acre tract at the California station,[21] Johnson grass was eradicated by plowing in the spring, working the soil into a good tilth, and using at intervals of about 10 days from May 1 to August 20 an implement equipped with knifelike blades regulated to cut about 3 inches beneath the surface of the ground.

In Texas, Pollock[22] advocates a similar method of nonuse of the land and repeated cutting of the plants underground throughout the growing season as an effective way to prevent the growth of new rootstocks and to exhaust the old ones. Under favorable conditions some use of the land can be obtained in connection with summer fallow. Results of experiments with Johnson grass in southern Texas[23] indicated that it was cheaper and more effective to supplement clean summer fallow with a winter crop of oat hay than to keep the land fallow throughout the year with intensive cultivation.

Heard[24] states that dry fallow as a means of killing Johnson grass on irrigated lands in Arizona is reasonably effective and economical when followed by winter grains, but attention is called to the fact that a heavy rain or an accidental leakage of irrigation water may undo a great deal of work.

According to Overpeck[25] in New Mexico, "clean summer fallowing with frequent shallow cultivations with a knife cultivator will eradicate the grass in one season. Midsummer plowing while very dry, followed by frequent use of a spring-tooth harrow, is often quite effective." The statement is made, however, that experience of farmers indicates that there is no easy method of eradicating Johnson grass. Much expense and a large amount of work must be expected.

It is generally conceded that under favorable conditions Johnson grass can be eradicated by growing thoroughly tilled crops for two or three years in succession, but ordinarily this is not an economical method, as it requires a large amount of cultivation, including hoeing. In tilling a crop or in working fallow land, various agricultural experiment stations have emphasized the necessity of careful, intensive cultivation, both to exhaust the Johnson-grass rootstocks and to kill the seedlings, which, according to the Arizona station, do not form rootstocks until about the time the stalk begins to head. Careless tillage with hoe or cultivator is largely wasted effort, as it only stimulates the grass to make a stronger growth.

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[21] HUNT, T. F. JOHNSON GRASS ERADICATION. Calif. Agr. Expt. Sta. Ann. Rpt. 1914–15: 29. 1915.

[22] See footnote 13.

[23] HEADLEY, F. B., and HASTINGS, S. H. THE WORK OF THE SAN ANTONIO EXPERIMENT FARM IN 1908. U. S. Dept. Agr., Bur. Plant Indus. Circ. 34: 16–17. 1909.

[24] See footnote 16.

[25] See footnote 19.

MISCELLANEOUS METHODS OF CONTROL

On land adapted to its growth alfalfa is of value for thinning Johnson grass if vigorous stands of the alfalfa are established. Hogs turned on freshly plowed Johnson-grass land will root through the loose soil and feed upon the fleshy rootstocks, but "there are usually enough rootstocks left in the soil to reestablish the grass."[26] According to reports from farms in New Mexico,[27] pasturing geese in cotton fields infested with Johnson grass reduced the amount of hand-hoeing required.

In vineyards and similar situations Johnson grass should invariably be cut back by the time it heads, earlier if possible; and the closer it is cut back the better. During midsummer or a little later all the top growth should be removed with a hoe, care being used to cut deep enough to remove the crown of every plant, and especially any tertiary rootstocks that are beginning to develop. It is probable, though not demonstrated, that if the tertiary growth is wholly prevented for two seasons the pest will be well under control. This of course means a great deal of handwork, but where ordinary cultural methods can not be applied the handwork seems necessary.

Weed-killing chemicals have not been used widely for controlling Johnson grass in fields. In general, chief reliance has been placed on tillage and cropping systems, including grazing by livestock. Field methods may not be applicable, however, to situations such as fence rows, railroad rights of way, and ditch banks. In order to keep seed from ripening in such places, one must usually resort to chemical methods of control or to repeated cutting, supplemented under some conditions by burning. For controlling Johnson grass the relative effectiveness and economy of chemical weed killers now available and of chemicals compared with other control methods have not been determined by the United States Department of Agriculture. Advice on these points therefore can not be given at this time.

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[26] See footnote 3.

[27] See footnote 19.

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February 27, 1928

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